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(54) OPTICAL FIBER CUTTER

(57) An optical fiber cleaver, comprising a blade capable of applying a scratch to the outer peripheral surface of an optical fiber and a pusher pushing the optical fiber to cleave it at the scratched part, wherein it further comprises a reverse-running prevention mechanism which prevents the blade which was moved directly and gave scratch to the optical fiber from being directly moved reversely and giving scratch again to the optical fiber, the reverse-running prevention mechanism comprises a cam moved directly in connection with the

blade and a cam follower being in contact with the cam and capable of directly moving the pusher, and the cam presses the pusher automatically against the optical fiber for cleavage after the optical fiber has been scratched by the blade and, after the scratch has been given completely, locked with the cam follower so as to suppress the cam from being moved directly in the reverse direction.

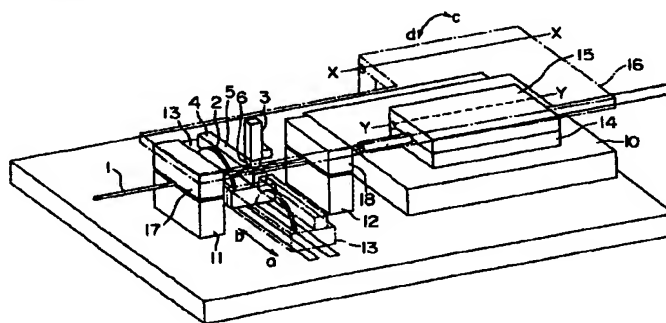


FIG. 1

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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an optical fiber cleaver for cleaving an optical fiber so that a cleaved section is formed as a mirror surface.

Description of the Related Art

[0002] An optical fiber has a tendency that, when a scratch is formed on the outer peripheral surface of an optical fiber from which a sheath or coating was peeled and the scratch is grown by pulling or bending the fiber, the fiber is broken at the scratch at once to obtain mirror end surfaces suitable for connection or splicing. In the past, there have been proposed various cleavers for performing such cleaving, including a cleaver proposed by the Inventors, in which a cleaving operation can be facilitated or undesired scratch(s) is not formed in the cleaved surface and therearound. Examples are shown in Figs. 7 and 8.

[0003] Fig. 7 shows an example of a cleaver in which the cleaving operation is facilitated and is a view of the cleaver, looked at from an optical axis of an optical fiber A. In this cleaver, when the optical fiber A from which a coating was peeled is pinched between upper and lower clamp members B, C and a slider D is directly moved in a direction shown by the arrow a, a blade E mounted on a distal end of the slider D gives a scratch to a lowermost part of the optical fiber A, and then, a cam follower F provided on the slider D lifts an end I of a pusher G pivoted around a shaft X, with the result that the other end J of the pusher G is lowered to apply stress to the scratch of the optical fiber A, thereby cleaving the optical fiber A at the scratch. In this case, the slider D is automatically slid by a motor H, and the operation is automatically performed by turning ON a switch.

[0004] Fig. 8 is a plan view of a cleaver in which an undesired scratch is not formed in the cleaved surface of an optical fiber. In this cleaver, when the optical fiber A from which a coating was peeled is pinched between supporting clamp members L fixed to a base K and pressing clamp members N fixed to a lid plate M and a slider O is directly moved in a direction shown by the arrow a, a blade P mounted on the slider O gives a scratch to a lowermost part of the optical fiber A, and the slider O is stopped by attracting it to a magnet Q disposed in front of the slider. Then, when a pusher R provided on the lid plate M is lowered, stress is applied to the scratch of the optical fiber A by the pusher R, thereby cleaving the optical fiber A at the scratch. Another magnet Q is disposed behind the slider O so that accidental movement of the slider O is prevented.

[0005] Although various optical fiber cleavers have been proposed till now, there are few cleavers in which

both operability and functionality are excellent. For example, in the cleaver shown in Fig. 7, since the pusher G for applying the stress to the optical fiber A is pivoted around the shaft X, when a multi fiber ribbon fiber is handled, due to difference in distance from the fulcrum, bending strokes between fibers are differentiated not to attain the uniform bending stress, with the result that the uniform mirror surface may not be obtained. Further, in the cleaver shown in Fig. 8, after the scratch was given to the optical fiber A, the slider O is attracted to the magnet Q to prevent undesired scratch from being given to the optical fiber A. However, since the slider O must be returned to its original starting position before starting a next operation, a magnetic force is relatively small. Thus, the slider O may be returned erroneously to give undesired scratch to the optical fiber A.

SUMMARY OF THE INVENTION

[0006] According to a first aspect of the present invention, there is provided an optical fiber cleaver comprising a blade movable directly in a direction perpendicular to an optical axis of an optical fiber clamped and capable of giving a scratch to the outer peripheral surface of an optical fiber, and a pusher movable linearly in the direction perpendicular to the optical axis of the optical fiber clamped and for pushing the optical fiber to cleave it at the scratched part and wherein it further comprises a reverse-running prevention mechanism which prevents the blade which was moved directly and gave the scratch to the optical fiber from being directly moved reversely and giving a scratch to the optical fiber again.

[0007] According to a second aspect of the present invention, in the optical fiber cleaver, the reverse-running prevention mechanism comprises a cam moved directly in connection with the blade and a cam follower being contacted with the cam and capable of directly moving the pusher, and, after the optical fiber has been scratched by the blade, the cam is locked with the cam follower so as to prevent the cam from being directly moved reversely.

[0008] According to a third aspect of the present invention, in the optical fiber cleaver, the reverse-running prevention mechanism comprises a cam moved directly in connection with the blade and a cam follower being contacted with the cam and capable of directly moving the pusher, and the cam presses the pusher automatically against the optical fiber for cleavage after the optical fiber has been scratched by the blade and, after the scratch has been given completely, is locked with the cam follower so as to prevent the cam from being directly moved reversely.

[0009] According to a fourth aspect of the present invention, in the optical fiber cleaver, after the optical fiber has been scratched by the blade, the cam lowers the pusher and is capable of maintaining the pusher in

a lowered condition thereafter.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a perspective view showing an optical fiber cleaver according to an embodiment of the present invention;

Fig. 2 is a sectional view for explaining a relationship between a pusher and a cam follower and a cam in the cleaver of Fig. 1;

Figs. 3A to 3H are explanatory views for explaining a fiber cleaving operation of the cleaver of Fig. 1, where Figs. 3A, 3C, 3E and 3G are side views, and Figs. 3B, 3D, 3F and 3H are front views;

Figs. 4A and 4B are sectional views of an optical fiber cleaver according to another embodiment of the present invention, showing a relationship between a pusher and a cam follower and a cam;

Figs. 5A to 5F are explanatory views for explaining a fiber cleaving operation of the cleaver of Fig. 4, where Figs. 5A, 5C and 5E are side views, and Figs. 5B, 5D and 5F are front views;

Figs. 6A to 6F are explanatory views showing further operations following to the fiber cleaving operation of Figs. 5A to 5F, where Figs. 6A, 6C and 6E are side views, and Figs. 6B, 6D and 6F are front views;

Fig. 7 is an explanatory view showing an example of a conventional optical fiber cleaver; and

Fig. 8 is an explanatory view showing another example of a conventional optical fiber cleaver.

BEST MODES FOR CARRYING OUT THE INVENTION

(First embodiment)

[0011] Fig. 1 is a perspective view schematically showing an optical fiber cleaver according to a first embodiment of the present invention. The cleaver comprises fiber resting table 10 on which an optical fiber 1 is laid laterally, and receiving side clamp members 11, 12 for clamping a leading end portion (a portion of the fiber from which a coating was peeled) of the optical fiber 1 set on the fiber resting table 10, and a slider 13 is disposed between the receiving side clamp members 11 and 12 for sliding movement in a direction (a-b direction) perpendicular to an optical axis of the clamped optical fiber 1.

[0012] In the fiber resting table 10, the optical fiber 1 is laid on an optical fiber setting portion 14 on the table, and, by pivoting a fiber hold-down member 15 in a direction shown by the arrow c around an axis Y-Y, the optical fiber 1 can be fixed by the fiber hold-down member 15.

[0013] Although the receiving side clamp members

11, 12 can receive the leading end portion of the optical fiber 1 set on the fiber resting table 10 from the above and support the leading end portion, in this case, as shown in Fig. 3B, since fiber supporting surfaces of the receiving side clamp members 11, 12 are positioned lower than a fiber supporting surface of the fiber resting table 10, the optical fiber 1 does not contact with the clamp members 11, 12 (and maintain a floating condition) until the optical fiber 1 is held down by hold-down side clamp members 17, 18 which will be described later.

[0014] A sharp and hard blade 2 and an elongated prismatic cam 4 are fixed onto the slider 13. The blade 2 has semi-circular side surfaces so that it can give a scratch to a lowermost part of the clamped optical fiber 1 smoothly without applying an excessive force, and a height of the blade is selected so that an uppermost edge of the blade is lightly contacted with the lowermost part of the optical fiber 1 (Fig. 2). The cam 4 is disposed aside the blade 2 in parallel with the latter and can be moved directly in the directions a-b in Fig. 1 together with the blade 2. The cam 4 is designed (or configured) so that it can support a cam follower 6 while resting it on the cam, from a position (Fig. 3A) where the slider 13 has completely been retarded in the direction b to a position (Fig. 3C) where the slider is slid in the direction a to cause the blade 2 to give the scratch to the optical fiber 1 completely, and can unload the cam follower 6 downwardly at a position (Fig. 3E) after completion of application of scratch.

[0015] A lid plate 16 pivotable around an axis X-X is provided aside the fiber resting table 10. The lid plate 16 is provided with two hold-down side clamp members 17, 18 and a pusher 3. When the lid plate 16 is pivoted in a direction shown by the arrow c to be closed, the hold-down side clamp members 17, 18 can overlap onto the corresponding receiving side clamp members 11, 12, thereby clamping the bare portion of the optical fiber 1 between the clamps 11, 12 and 17, 18. Further, when the lid plate 16 is opened by pivoting it in a direction shown by the arrow d, the optical fiber 1 can be unclamped.

[0016] The pusher 3 is disposed between the hold-down side clamp members 17 and 18. As shown in Fig. 2, the pusher 3 is housed in a cylinder 20 fixed to the lid plate 16 so that the pusher can be moved directly in a thickness direction of the lid plate 16. In this case, a coil spring 19 is provided between the cylinder 20 and the pusher 3 to protrude the pusher 3 from a rear surface of the lid plate 16. As shown in Figs. 2 and 3, a hook-shaped cam follower 6 is provided aside the pusher 3 so that, when the lid plate 16 is closed, a lower end of the pusher 3 is positioned immediately above the optical fiber 1 and the cam follower 6 is positioned in a sliding path of the cam 4. When the slider 13 is in a position shown by the solid line in Fig. 1, the cam follower 6 rides on the cam 4 and is held in a lifted condition, with the result that the pusher 3 is also lifted to be retarded

above the optical fiber 1. However, when the slider 13 is slid in the direction a to reach a position shown by the broken line in Fig. 1, the cam follower is disengaged from the cam 4 and is dropped, with the result that the pusher 3 is lowered to push the outer peripheral surface of the optical fiber 1 from the above. Once the cam follower 6 is disengaged from the cam 4 and is dropped, since opposed surfaces of the cam and cam follower 6 are vertical, the cam follower cannot ride on the cam 4 again (Fig. 3E), with the result that the blade 2 cannot be returned to the direction b together with the cam 4. Incidentally, in Fig. 2, the reference numeral 21 denotes a dislodgement preventing screw for preventing the pusher 3 from being dislodged from the cylinder 20; and 22 denotes a blind lid.

[0017] Now, an optical fiber cleaving sequence of the optical fiber cleaver will be explained.

(1) As shown in Fig. 1, the optical fiber 1 is set on the fiber resting table 10. In this case, the slider 13 is previously retarded in the direction b.

(2) The lid plate 16 shown in Fig. 1 is closed to pinch the optical fiber 1 between the clamp members 11, 12 and 17, 18, as shown in Figs. 3A and 3B.

(3) The slider 13 is slid in the direction a.

(4) When the slider 13 reaches the position shown in Fig. 3C, the blade 2 gives the scratch to the lowermost part of the optical fiber 1. In this case, the cam follower 6 still rides on the cam 4 so that the pusher 3 is retarded above the optical fiber 1 (Fig. 3D).

(5) When the slider 13 reaches the position shown in Fig. 3E, the application of the scratch to the lowermost part of the optical fiber 1 by means of the blade 2 is completed, and the cam follower 6 is disengaged from the cam 4 to lower the pusher 3, with the result that the optical fiber 1 is broken at the scratch (Fig. 3F). In this condition, if the slider 13 tries to be retarded in the direction b, since the cam follower 6 cannot ride on the cam 4, the slider cannot be retarded. Further, since the pusher 3 is in the lowered condition, end faces of the broken optical fibers are not contacted with each other, thereby preventing the end faces from being damaged.

(6) The lid plate 16 is opened to release the clamping of the optical fiber 1 by means of the clamp members 11, 12, 17, 18. Since the optical fiber 1 set on the fiber resting table 10 is jumped upwardly as shown in Fig. 3H, it does not contact with the blade 2, and, since the opposite side waste fiber remains on the receiving side clamp member 11 lower than the fiber resting table 10, the optical fiber on the table does not contact with the waste fiber, with the result that undesired scratch (damage) is not applied to the optical fiber 1 on the fiber resting table 10. Further, by opening the lid plate 16, the cam follower 6 is disengaged from the cam 4 com-

pletely, with the result that the slider 13 can be moved freely. Thus, by shifting the slider in the direction b, a next cleaving operation can be started.

(Second embodiment)

[0018] Fig. 4 shows an optical fiber cleaver according to a second embodiment of the present invention, in which the cam 4, pusher 3 and cam follower 6 in the cleaver of Fig. 1 are improved. Similar to the first embodiment, a cam 4 is fixed to the slider 13 and is shaped to have an uneven cam surface as shown in Fig. 4B. A pusher 3 and a cam follower 6 are independently provided on the lid plate 16 so that they can be moved directly along a thickness direction of the lid plate 16 in opposite directions by the presence of a gear 25 therebetween. That is to say, when the cam follower 6 is lifted the pusher 3 is lowered, and, when the cam follower 6 is lowered the pusher 3 is lifted. Incidentally, the cam follower 6 is protruded from a lower surface of the lid plate 16 by a coil spring 26 to be always contacted with the cam 4. Immediately after the slider 13 is slid in the direction a and the blade 2 shown by the broken line in Fig. 4B gives the scratch to the optical fiber 1, the cam follower 6 is gradually lifted along an ascent of the cam 4, and accordingly, the pusher 3 is gradually lowered, thereby applying stress to the optical fiber 1. When the slider 13 is further slid in the direction a and the application of the scratch to the optical fiber 1 is completed, the cam follower is dropped into a small concave after passing through a horizontal cam surface contiguous to the ascent, thereby preventing the cam 4 from being moved in the direction b.

[0019] Now, an example of usage of the optical fiber cleaver of Figs. 4A and 4B will be explained.

(1) As shown in Figs. 5A and 5B, the optical fiber 1 is set on the fiber resting table 10. In this case, the slider 13 is previously retarded in the direction b.

(2) As shown in Figs. 5C and 5D, the lid plate 16 is closed to pinch the optical fiber 1 between the clamp members 11, 12 and 17, 18. In this condition, the cam follower 6 rides on the lowermost cam surface of the cam 4 and the pusher 3 is waiting above the optical fiber 1.

(3) The slider 13 is slid in the direction a.

(4) When the slider 13 reaches the position shown in Fig. 5E, the blade 2 gives the scratch to the lowermost part of the optical fiber 1. In this case, the cam follower 6 still contacts with the lowermost cam surface of the cam 4 and the pusher 3 is still waiting above the optical fiber 1.

(5) When the slider 13 reaches the position shown in Fig. 6A, the cam follower 6 is gradually lifted along the ascent of the cam 4 and thus the pusher 3 is gradually lowered, thereby bending the optical fiber 1 slowly to cleave it (Fig. 6B).

(6) When the slider 13 reaches the position shown in Fig. 6C, the cam follower 6 is dropped into the concave of the cam 4 to slightly lift the pusher 3 as shown in Fig. 6D and to prevent the cam 4 from sliding in the direction b.

(7) The lid plate 16 is opened to release the clamping of the optical fiber 1 by means of the clamp members 11, 12, 17, 18. Since the released optical fiber 1 is set on the fiber resting table 10 higher than the clamp members 11, 12, such optical fiber is jumped upwardly as shown in Figs. 6E and 6F. Further, by opening the lid plate 16, the cam follower 6 is disengaged from the cam 4 completely, with the result that the slider 13 can be moved freely. Thus, the slider 13 can be shifted in the direction b for a next cleaving operation.

Industrial Availability

[0020] The optical fiber cleaver according to the first or second aspect of the present invention provides the following advantages:

1. Since the application of the scratch to the optical fiber by means of the blade is not repeated, undesired scratch is not given to the fiber.
2. Since the pusher is moved directly to push the optical fiber, even in a multi fiber ribbon fiber, uniform bending stress can be applied to all of the fibers, and, since there is no arc movement, unwanted force such as a twisting force is not applied to the optical fiber.

[0021] In the optical fiber cleaver according to the third aspect of the present invention, after the application of the scratch to the optical fiber by means of the blade is completed, since the pusher automatically pushes the optical fiber to cleave it, the cleaving operation can be performed by one action.

[0022] In the optical fiber cleaver according to the fourth aspect of the present invention, even after the optical fiber is cleaved by the pusher, the pusher can push the optical fiber continuously, the cleaved optical fibers can be prevented from being contacted with each other.

Claims

1. An optical fiber cleaver comprising:

a blade movable directly in a direction perpendicular to an optical axis of an optical fiber clamped and capable of giving a scratch to the outer peripheral surface of an optical fiber; and a pusher movable linearly in the direction perpendicular to the optical axis of the optical fiber clamped and for pushing the optical fiber to cleave it at the scratched part;

and wherein

it further comprises a reverse-running prevention mechanism which prevents said blade which was moved directly and gave the scratch to the optical fiber from being directly moved reversely and giving a scratch to the optical fiber again.

2. An optical fiber cleaver comprising:

a blade movable directly in a direction perpendicular to an optical axis of an optical fiber clamped and capable of giving a scratch to the outer peripheral surface of an optical fiber; and a pusher movable linearly in the direction perpendicular to the optical axis of the optical fiber clamped and for pushing the optical fiber to cleave it at the scratched part; and wherein it further comprises a reverse-running prevention mechanism which prevents said blade which was moved directly and gave the scratch to the optical fiber from being directly moved reversely and giving a scratch to the optical fiber again; said reverse-running prevention mechanism comprises a cam moved directly in connection with said blade and a cam follower being contacted with said cam and capable of directly moving said pusher; and after the optical fiber has been scratched by the blade, said cam is locked with said cam follower so as to prevent said cam from being directly moved reversely.

3. An optical fiber cleaver comprising:

a blade movable directly in a direction perpendicular to an optical axis of an optical fiber clamped and capable of giving a scratch to the outer peripheral surface of an optical fiber; and a pusher movable linearly in the direction perpendicular to the optical axis of the optical fiber clamped and for pushing the optical fiber to cleave it at the scratched part; and wherein it further comprises a reverse-running prevention mechanism which prevents said blade which was moved directly and gave the scratch to the optical fiber from being directly moved reversely and giving a scratch to the optical fiber again; said reverse-running prevention mechanism comprises a cam moved directly in connection with said blade and a cam follower being contacted with said cam and capable of directly moving said pusher; and said cam presses said pusher automatically against the optical fiber for cleavage after the

optical fiber has been scratched by said blade and, after the scratch has been given completely, is locked with said cam follower so as to prevent said cam from being directly moved reversely.

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4. An optical fiber cleaver comprising:

a blade movable directly in a direction perpendicular to an optical axis of an optical fiber clamped and capable of giving a scratch to the outer peripheral surface of an optical fiber; and a pusher movable linearly in the direction perpendicular to the optical axis of the optical fiber clamped and for pushing the optical fiber to cleave it at the scratched part;

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and wherein

it further comprises a reverse-running prevention mechanism which prevents said blade which was moved directly and gave the scratch to the optical fiber from being directly moved reversely and giving a scratch to the optical fiber again;

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said reverse-running prevention mechanism comprises a cam moved directly in connection with said blade and a cam follower being contacted with said cam and capable of directly moving said pusher;

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said cam presses said pusher automatically against the optical fiber for cleavage after the optical fiber has been scratched by said blade and, after the scratch has been given completely, is locked with said cam follower so as to prevent said cam from being directly moved reversely; and

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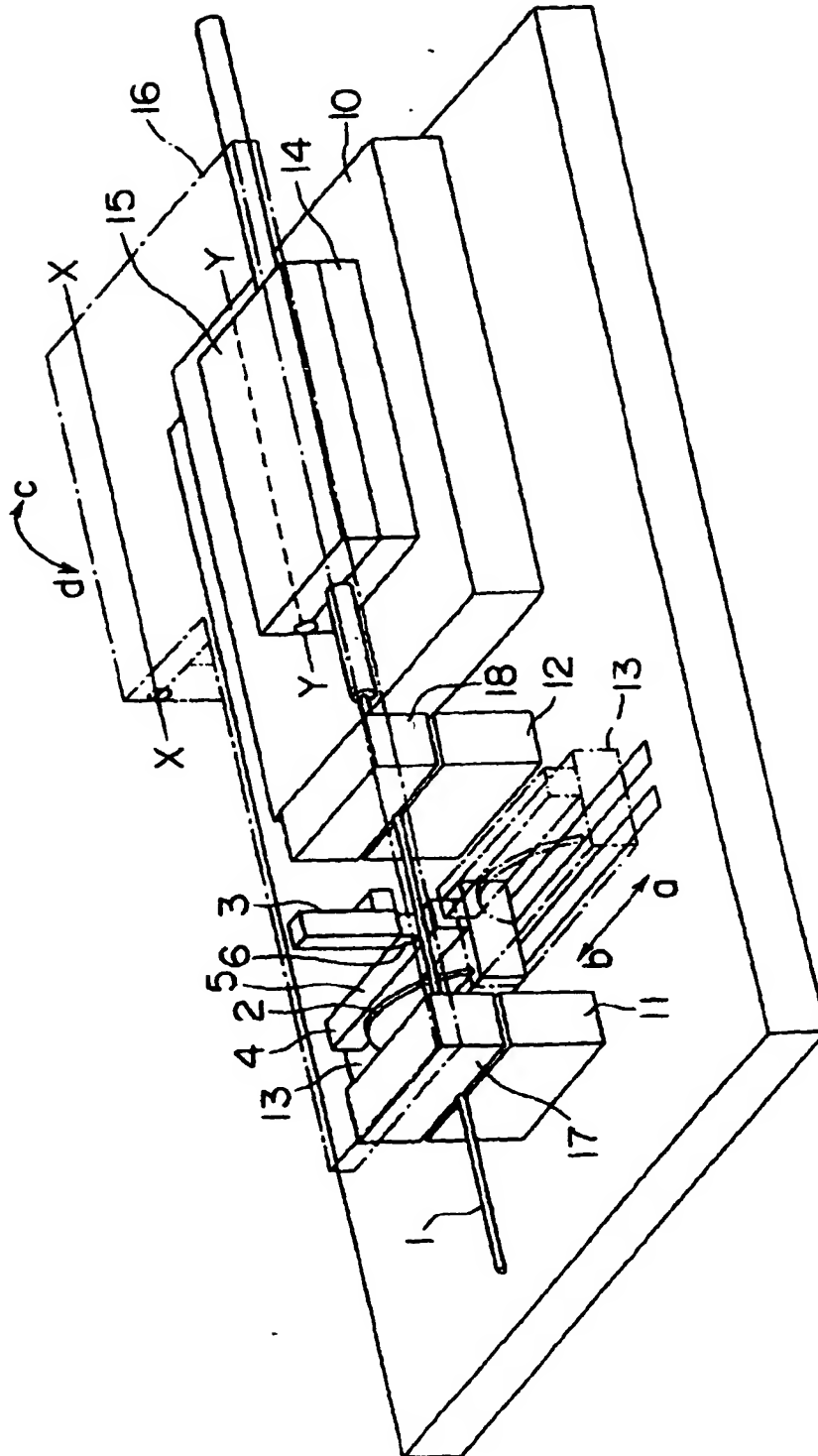
after the optical fiber has been scratched by said blade, said cam lowers said pusher and is capable of maintaining said pusher in a lowered condition thereafter.

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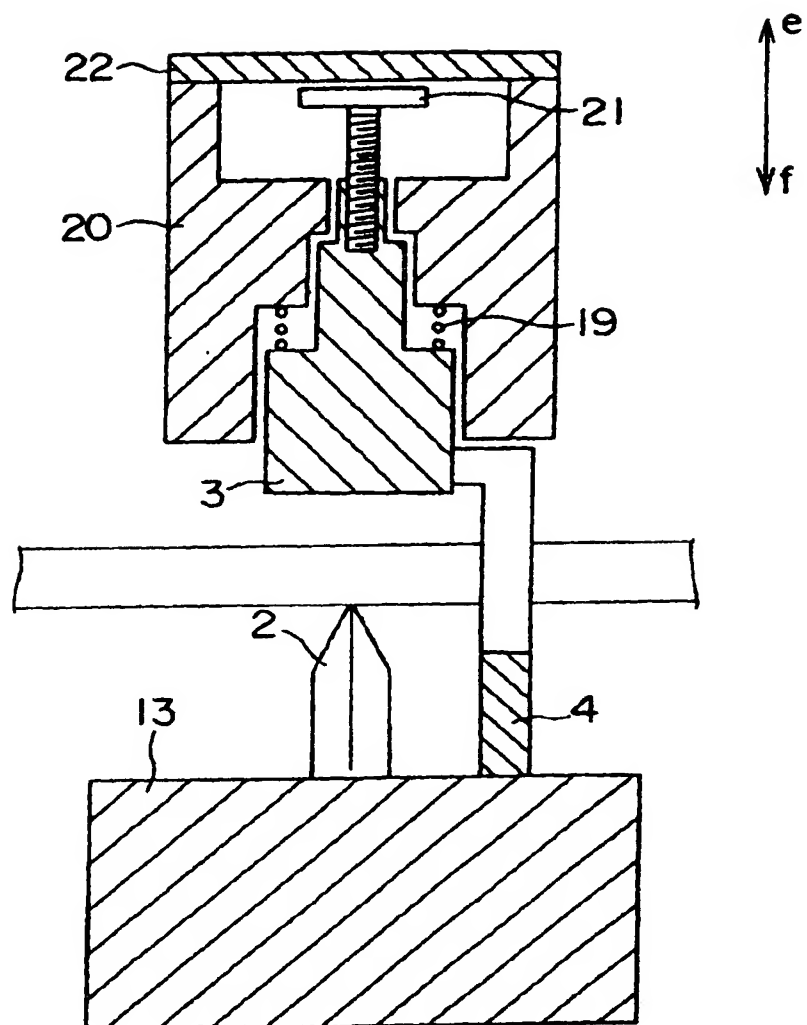


FIG. 2

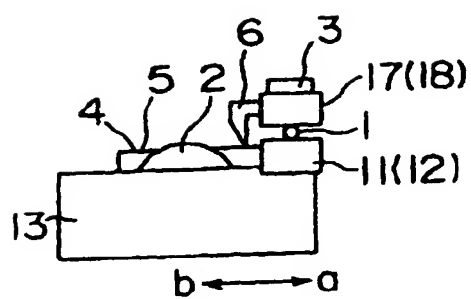


FIG. 3A

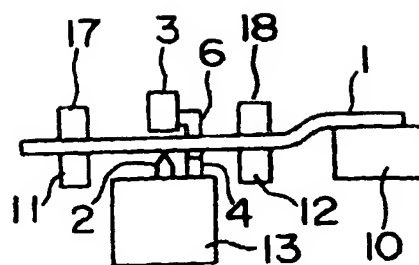


FIG. 3B

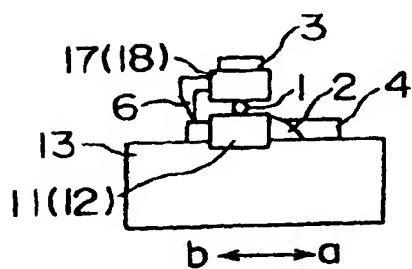


FIG. 3C

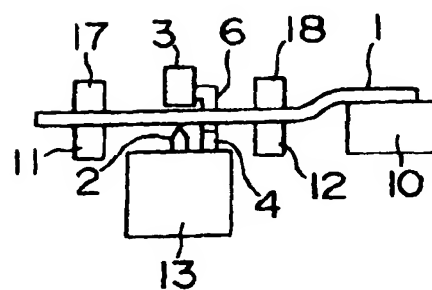


FIG. 3D

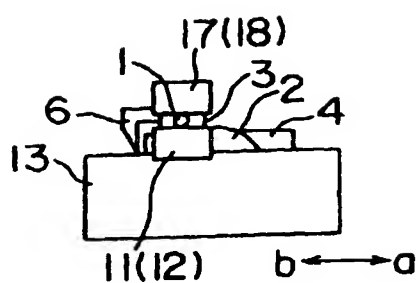


FIG. 3E

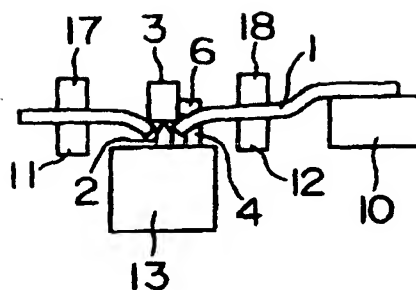


FIG. 3F

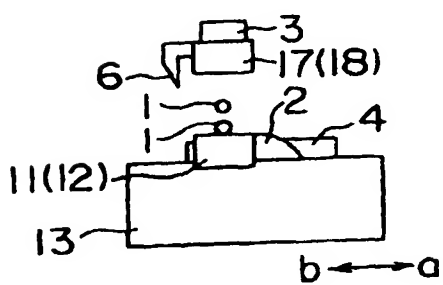


FIG. 3G

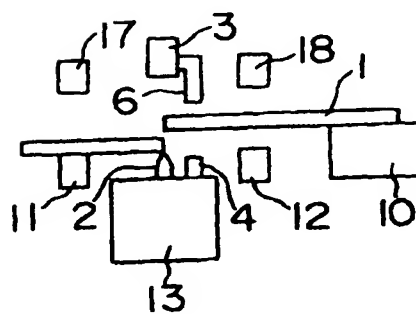


FIG. 3H

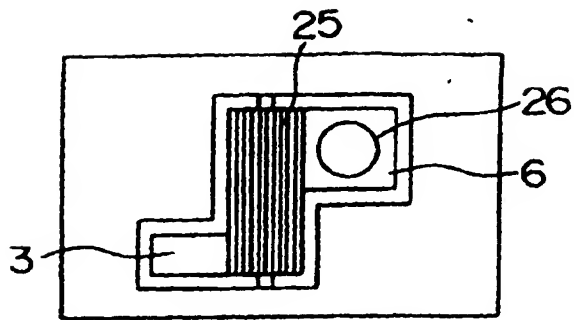


FIG. 4A

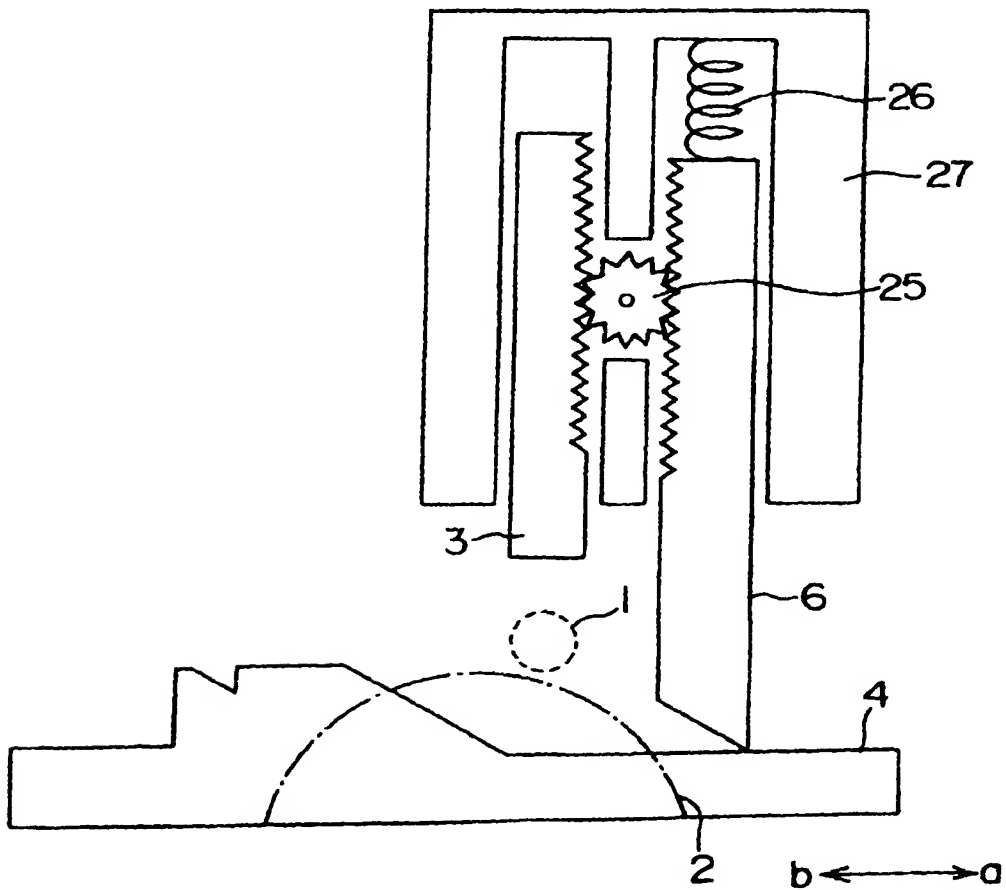


FIG. 4B

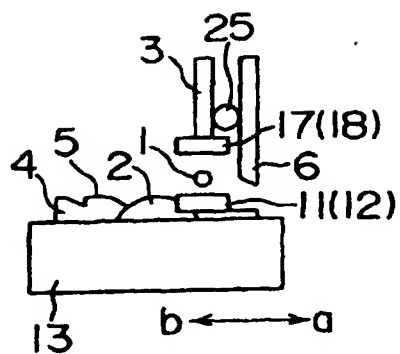


FIG. 5A

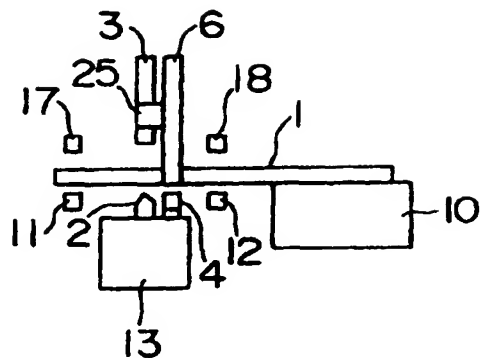


FIG. 5B

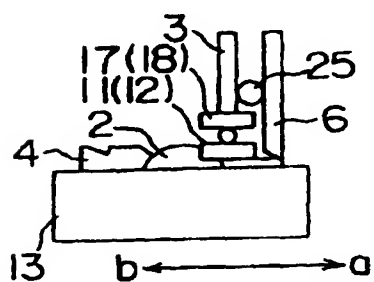


FIG. 5C

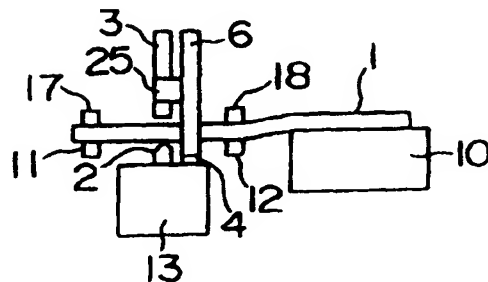


FIG. 5D

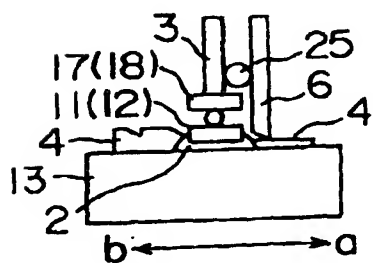


FIG. 5E

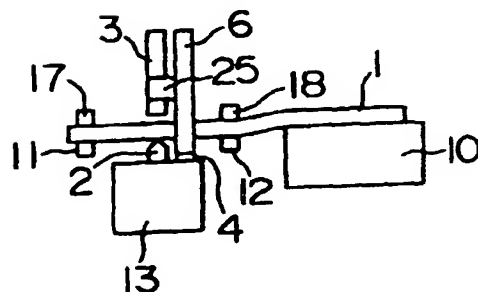


FIG. 5F

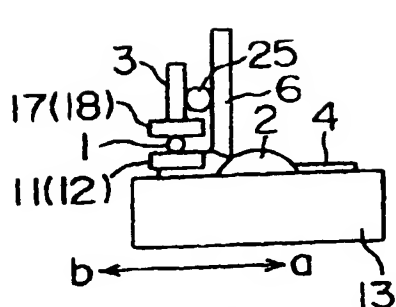


FIG. 6A

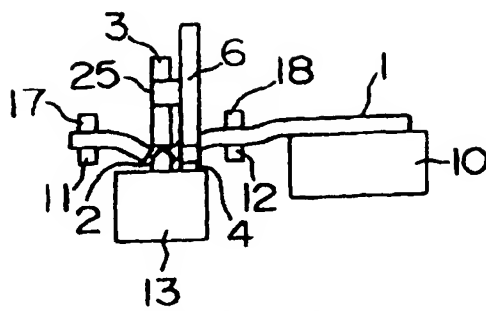


FIG. 6B

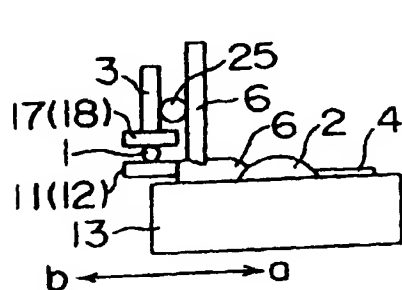


FIG. 6C

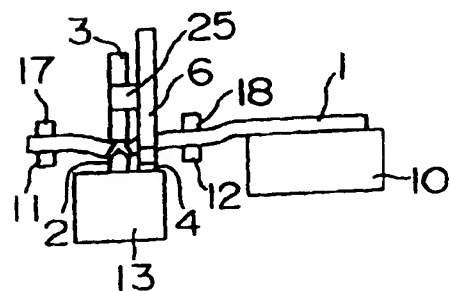


FIG. 6D

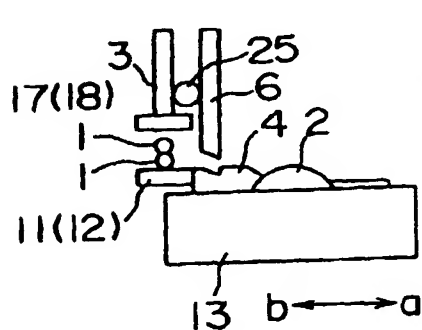


FIG. 6E

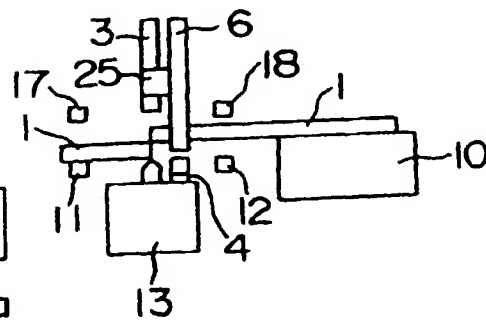


FIG. 6F

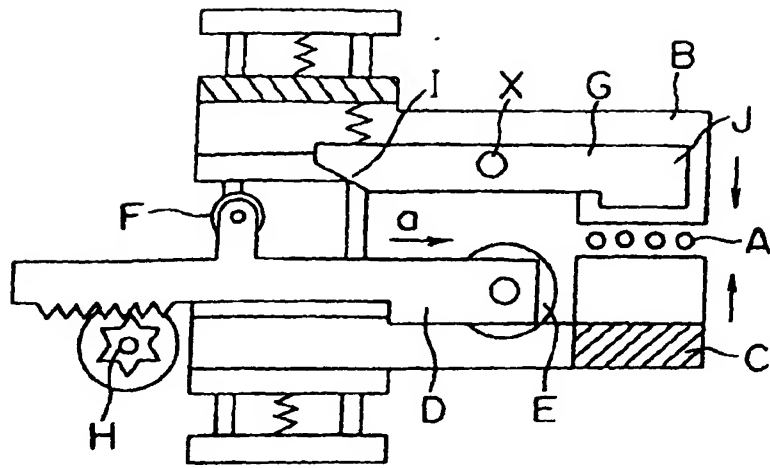


FIG. 7

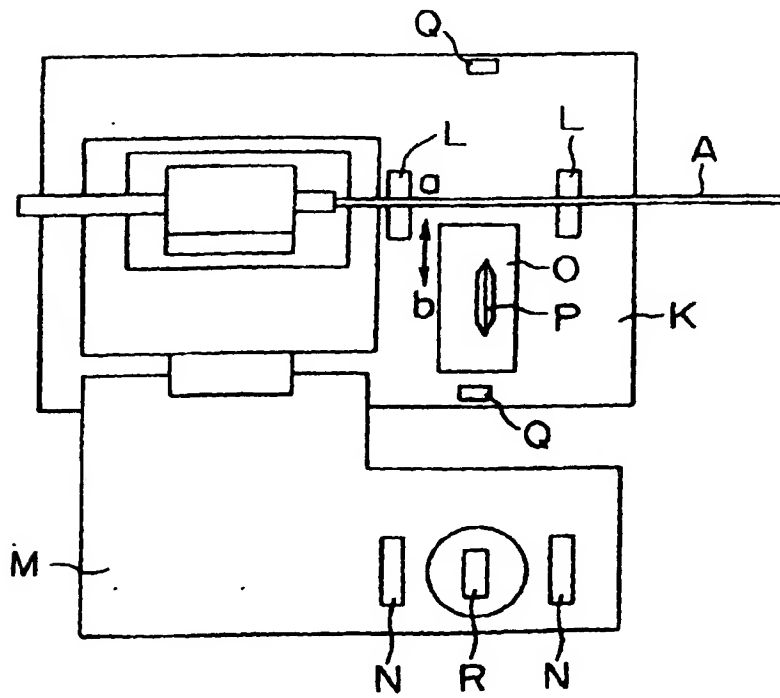


FIG. 8

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/JP99/04901

| A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁶ G02B6/00 | | |
|---|--|---|
| According to International Patent Classification (IPC) or to both national classification and IPC | | |
| B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁶ G02B6/00, G02B6/25, B26F3/00, C03B37/16 | | |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-1999 Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999 | | |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | JP, 8-5844, A (Fujikura Ltd.), 12 January, 1996 (12. 01. 96), Par. Nos. [0002] to [0005], [0009], [0010] ; Figs. 1, 3 (Family: none) | 1-4 |
| A | JP, 2-275908, A (Sumitomo Electric Industries, Ltd.), 9 November, 1990 (09. 11. 90), Page 2, lower right column, line 17 to page 3, upper right column, line 12 ; Fig. 1 (Family: none) | 1-4 |
| A | JP, 5-80219, A (Nippon Telegraph & Telephone Corp.), 2 April, 1993 (02. 04. 93), Par. Nos. [0002], [0003] ; Figs. 3, 4 (Family: none) | 1-4 |
| A | CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 5-76535 (Laid-open No. 7-40749) (Japan Aviation Electronics Industry, Ltd.), 21 July, 1995 (21. 07. 95), Page 8, lines 2 to 17 ; Figs. 1, 2 (Family: none) | 1-4 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex. | | |
| * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family | | |
| Date of the actual completion of the international search 20 October, 1999 (20. 10. 99) | | Date of mailing of the international search report 2 November, 1999 (02. 11. 99) |
| Name and mailing address of the ISA/ Japanese Patent Office | | Authorized officer |
| Facsimile No. | | Telephone No. |

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PCT/JP99/04901

| C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT | | |
|---|--|-----------------------|
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | JP, 5-232346, A (The Furukawa Electric Co., Ltd., et al.), 10 September, 1993 (10. 09. 93), Par. Nos. [0009], [0010] ; Figs. 1, 2 (Family: none) | 1-4 |

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